UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF PENNSYLVANIA

JILL STEIN, RANDALL REITZ, ROBIN
HOWE, SHANNON KNIGHT, and EMILY
COOK,

Plaintiffs,

-against-

No. 16-CV-6287 (PD)

KATHY BOOCKVAR, in her official capacity as
Acting Secretary of the Commonwealth; and
JONATHAN MARKS, in his official capacity as
Commissioner of the Bureau of Commissions,
Elections, and Legislation,

Defendants.

**DECLARATION OF J. ALEX HALDERMAN IN SUPPORT OF
PLAINTIFFS' MOTION TO ENFORCE THE SETTLEMENT AGREEMENT**

J. ALEX HALDERMAN declares under penalty of perjury pursuant to 28 U.S.C.
§ 1746, that the following is true and correct:

1.   My name is J. Alex Halderman. I am a professor of computer science and
engineering at the University of Michigan. My credentials, qualifications, and areas of expertise
are described more fully in my declaration previously filed in this action at Dkt. #8 and Exhibit
A thereto.

2.   I am familiar with the operation of the voting system manufactured by Election
Systems & Software called the ExpressVote XL. I have reviewed publicly available materials
describing the system's technical specifications, the Secretary of the Commonwealth's reports
certifying it for use in Pennsylvania, and reports certifying it for use in other jurisdictions.

3.   From the perspective of election security, there are two central advantages of a voting system that uses paper ballots: (1) it does not place a hackable computer between the voter and the official record of her vote; and (2) the voter's selections are recorded on a physical record that cannot later be changed by hackers. The ExpressVote XL does not share these central advantages of paper balloting systems.

4.   Although it records each voter's selections on a piece of paper, the ExpressVote XL works differently than most paper ballot systems. Despite its use of paper, its overall functioning bears more resemblance to a direct-recording electronic voting machine that produces a voter-verifiable paper audit trail (a "DRE with VVPAT" system). DRE with VVPAT systems provide inferior security to systems that use paper ballots.

5.   As in a DRE with VVPAT system, the ExpressVote XL prompts the voter to make selections on a computer. It then prints a summary of the voter's selections on a piece of paper that is held behind a transparent window. A prompt on the computer screen asks the voter whether to cast her vote. If the voter accepts the prompt, the paper is fed back through the machine and into a collection container.

6.   The paper on which the ExpressVote XL prints the voter's selections passes back through the printer on its way to being deposited in the collection bin. The system's software is designed to lift the printhead to prevent it from making any additional marks on the paper when the paper passes back through the machine. It would be feasible for malware to tamper with this function and cause the printhead to add additional races or selections to the paper after the voter has reviewed it. In this way, an attacker could change the voter's selections after the paper was out of the voter's sight.

7.   The ExpressVote XL scans the voter's paper record before, not after, she reviews it. The system's software is designed not to cast the votes until after the voter has accepted the printout. It would be feasible for malware to compromise this function and cause paper records that have been rejected by voters to be tabulated as well as those that have been accepted by voters. Such an attacker would cause the set of voted paper records to differ from voters' intended votes.

8.   The paper records printed by the ExpressVote XL contain the names of selected candidates and a set of bar codes that supposedly correspond to those selections. What is scanned and counted by the machine is not the human-readable names but only the non-human-readable bar codes. Voters have no practical way to verify that the bar codes correctly reflect their selections. It would be feasible for malware to cause the machine to print bar codes that corresponded to candidates the voter did not select. The result would be that the tabulated votes did not reflect the voter's choices, but the voter would not be able to detect this.

9.   Other ballot marking devices (BMDs) are not designed the same way. Many, if not most, BMDs produce ordinary paper ballots that are handled by the voter and fed into an optical scanner just like paper ballots that are filled out by hand.

10.   With a paper ballot system, a robust post-election audit can correct any computer-based error or fraud. This is not possible with the ExpressVote XL, because it would be feasible for malware to cause the paper records to differ from voters' actual votes. If hacking compromises the paper records, a post-election audit will arrive at the same wrong result.

Dated: November 21, 2019

_____
J. ALEX HALDERMAN